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Nakagawa et al.

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(54) **SHEET STACKING APPARATUS, SHEET FEEDING APPARATUS, AND IMAGE FORMING APPARATUS**

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(30) **Foreign Application Priority Data**

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B65H 1/12 (2006.01)

(52) **U.S. Cl.**
CPC ***B65H 1/12*** (2013.01); *B65H 2405/11151* (2013.01)

(58) **Field of Classification Search**
CPC B65H 1/12; B65G 2405/1116; B65G 2405/11163; B65G 2405/11151
USPC 271/148, 160
See application file for complete search history.

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(57) **ABSTRACT**

A sheet stacking apparatus includes a base member, a sheet stacking portion on which sheets are stacked, and a biasing portion configured to bias the sheet stacking portion.

The sheet stacking portion is swingably supported by the base member, and the biasing portion biases the sheet stacking portion such that a swing angle is reduced.

12 Claims, 11 Drawing Sheets

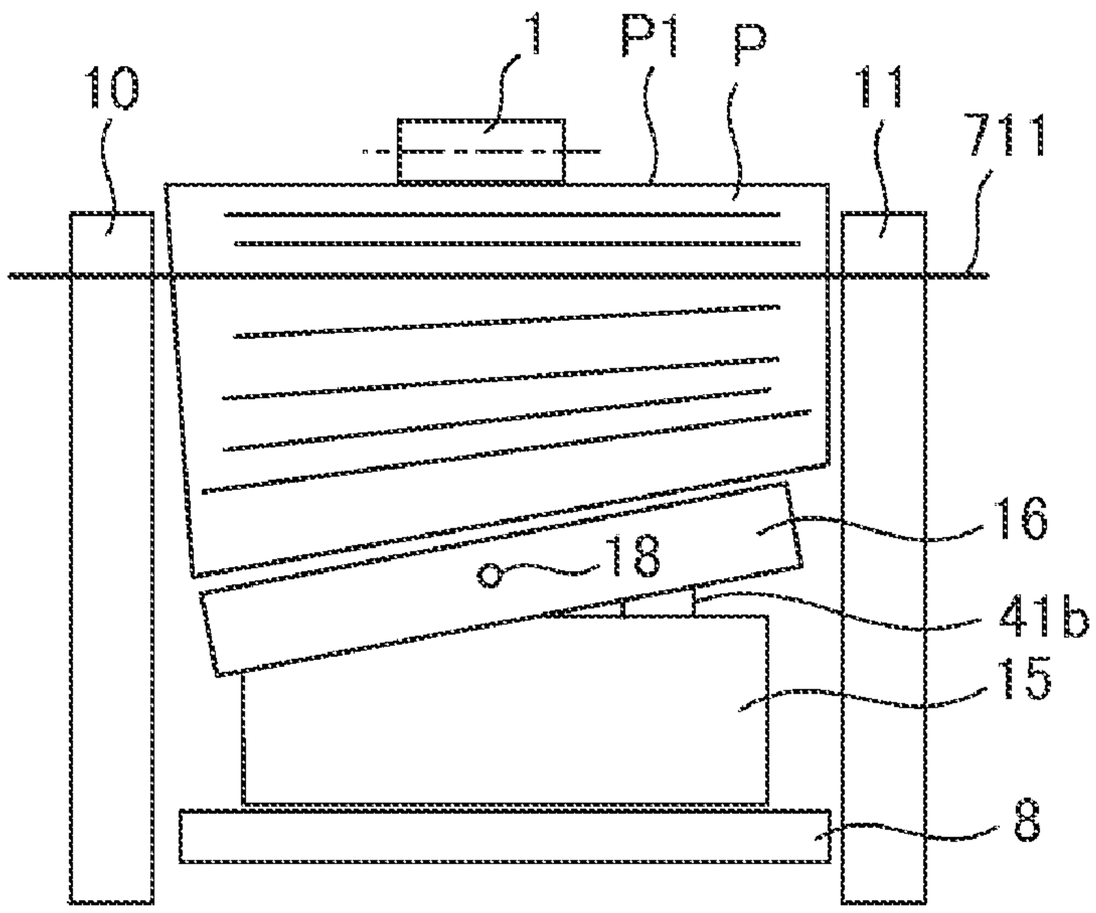


FIG.1

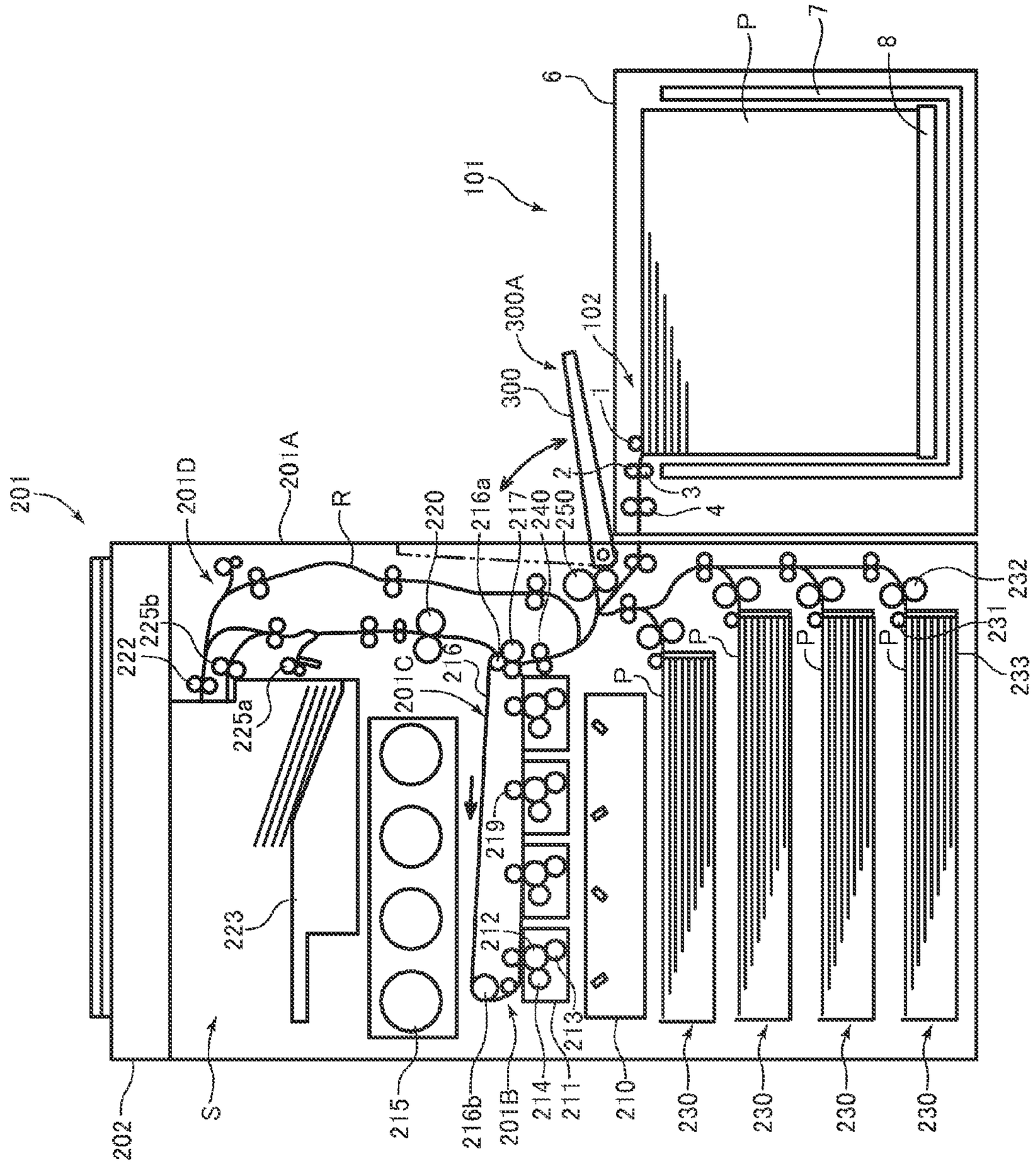

101
6
P
7
8
201
201D
201A
R
220
216a
217
240
250
2
300
300A
102
1
3
4
222
225b
225a
223
201C
216
219
212
213
P
232
231
233
202
S
215
216b
201B
214
211
210
230

FIG.2

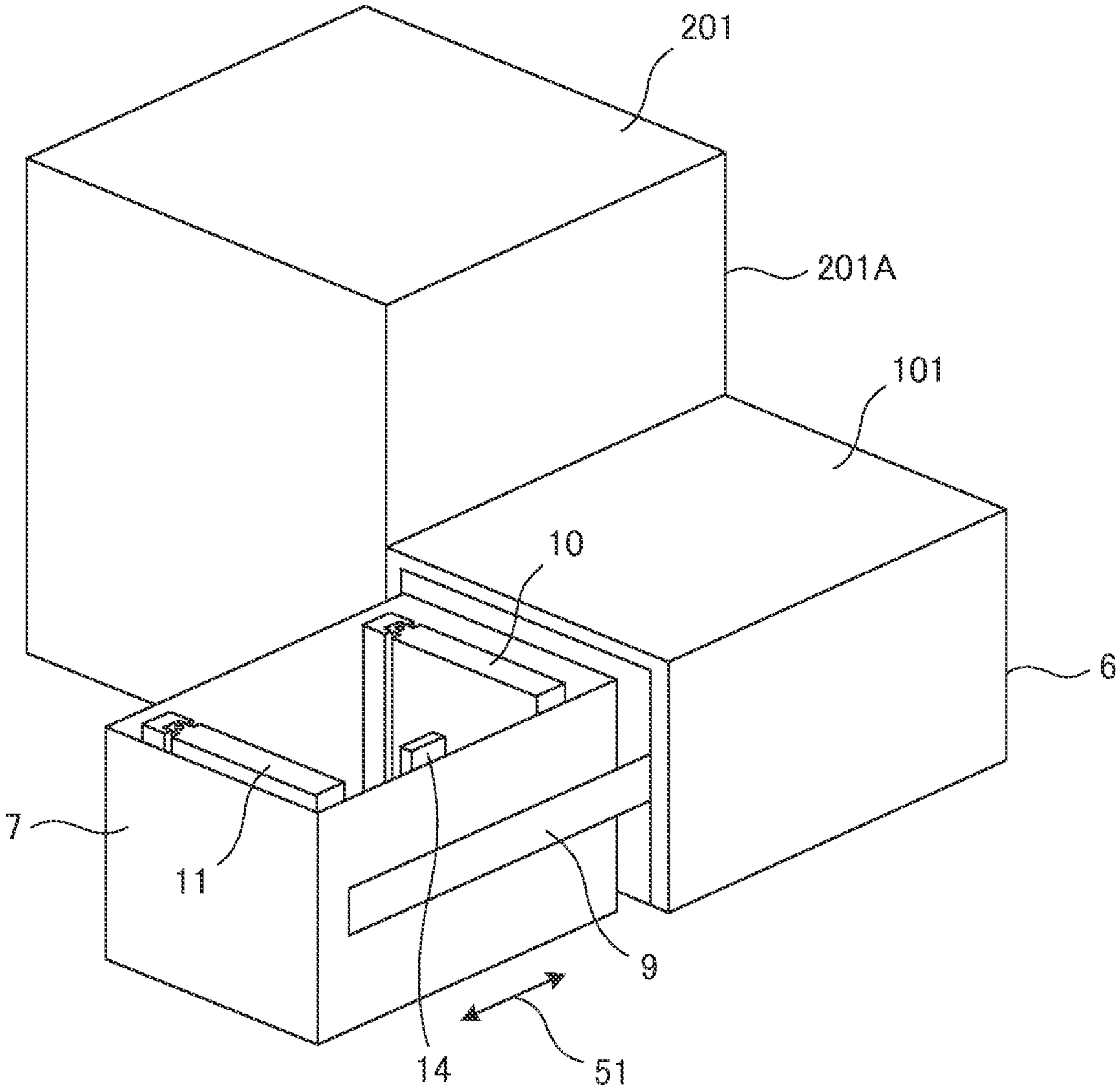


FIG.3

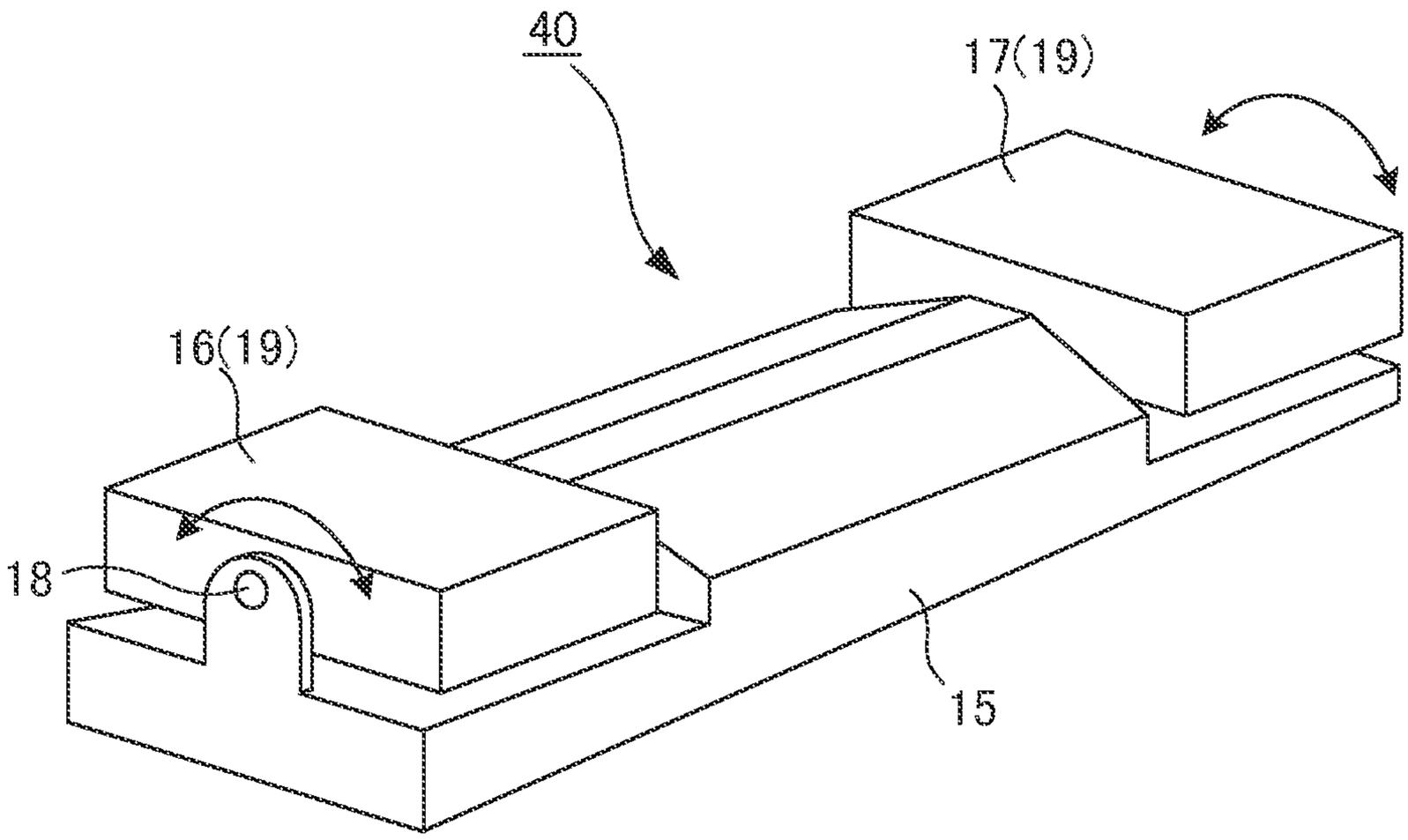


FIG.4

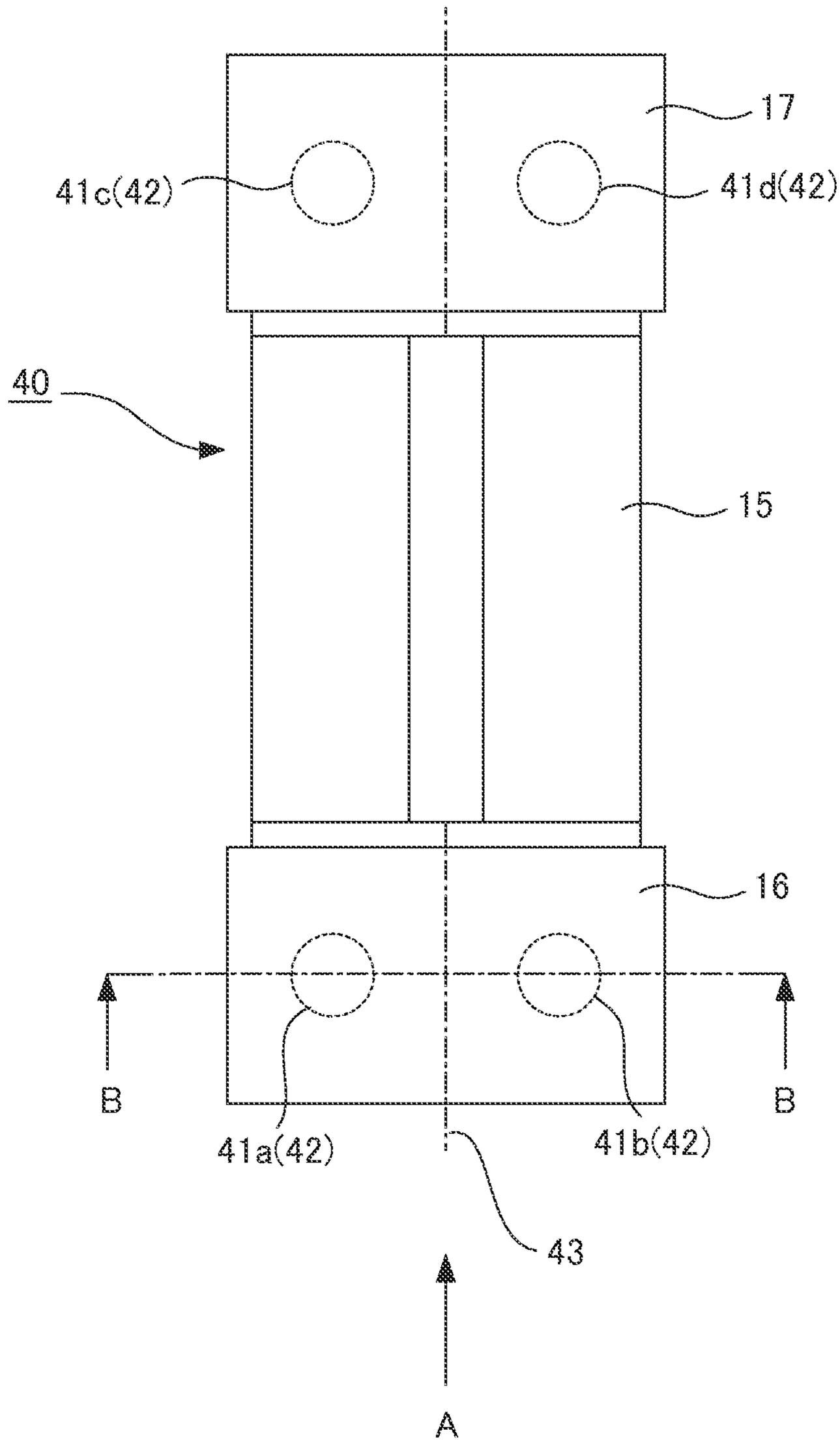


FIG.5

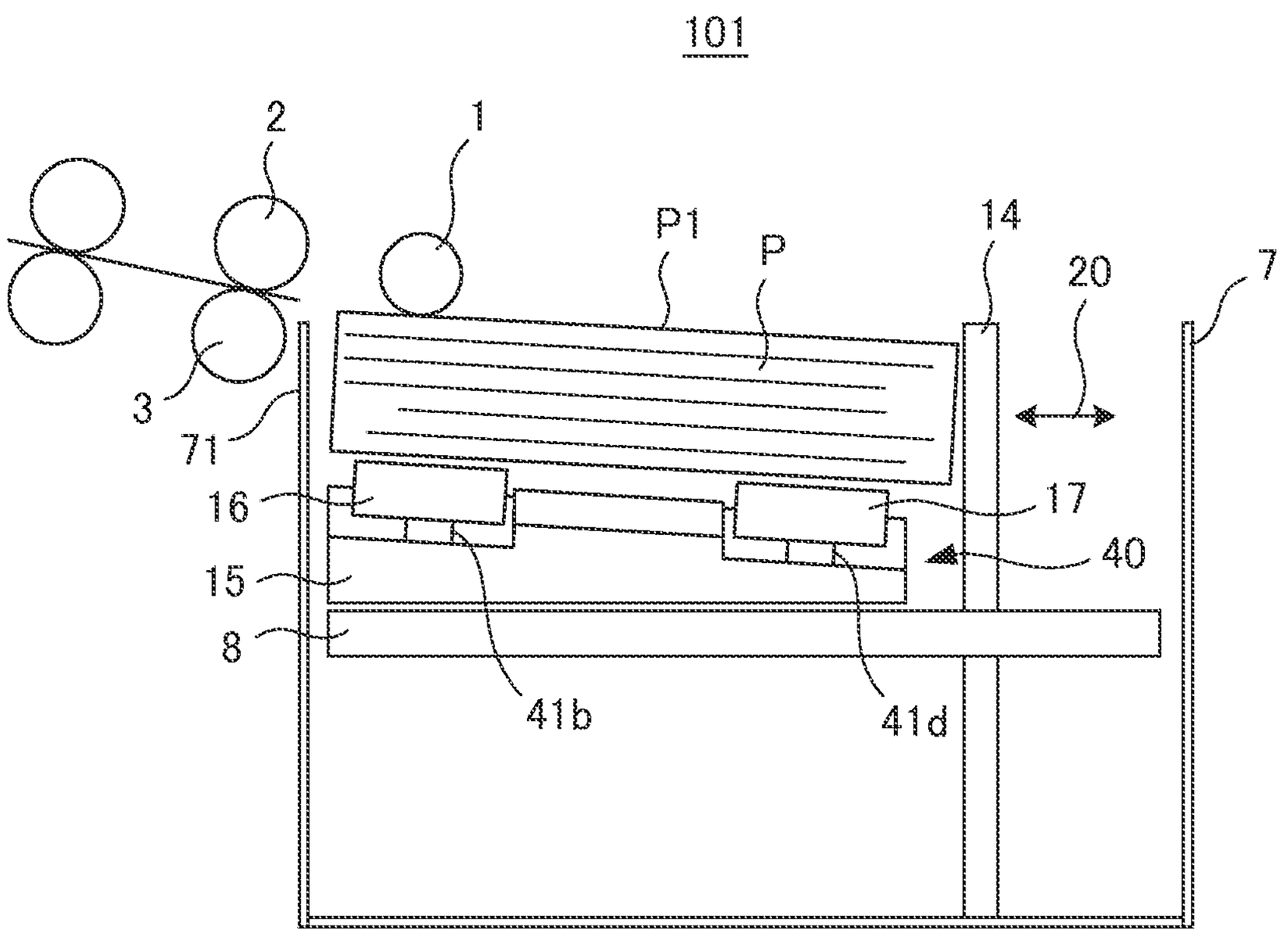


FIG.6A

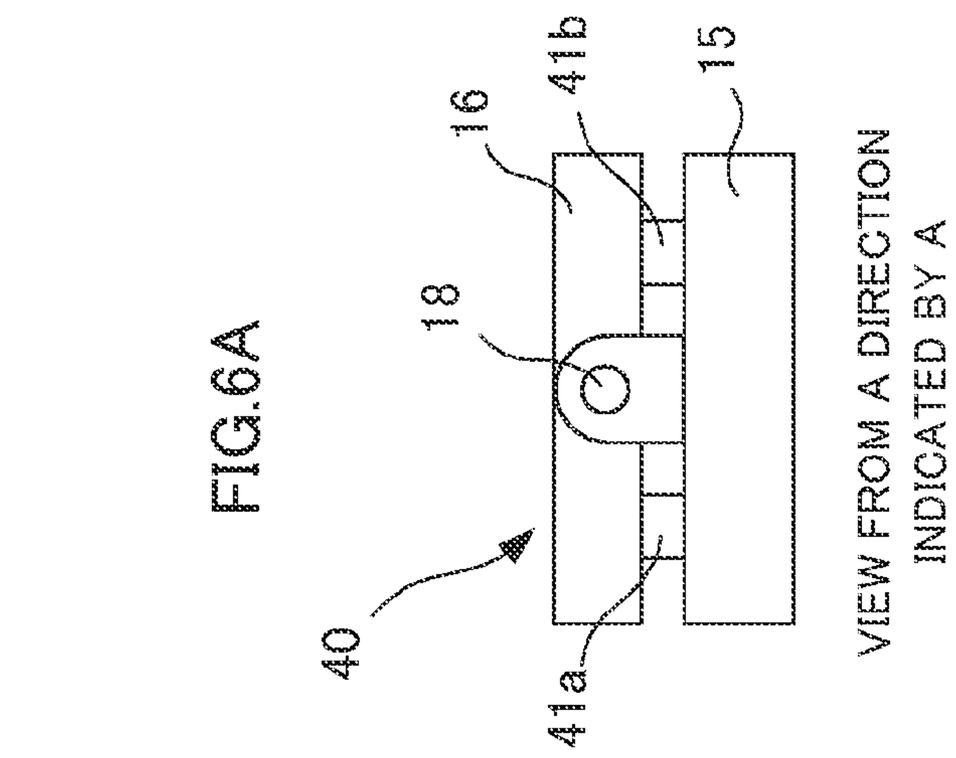


FIG.6B

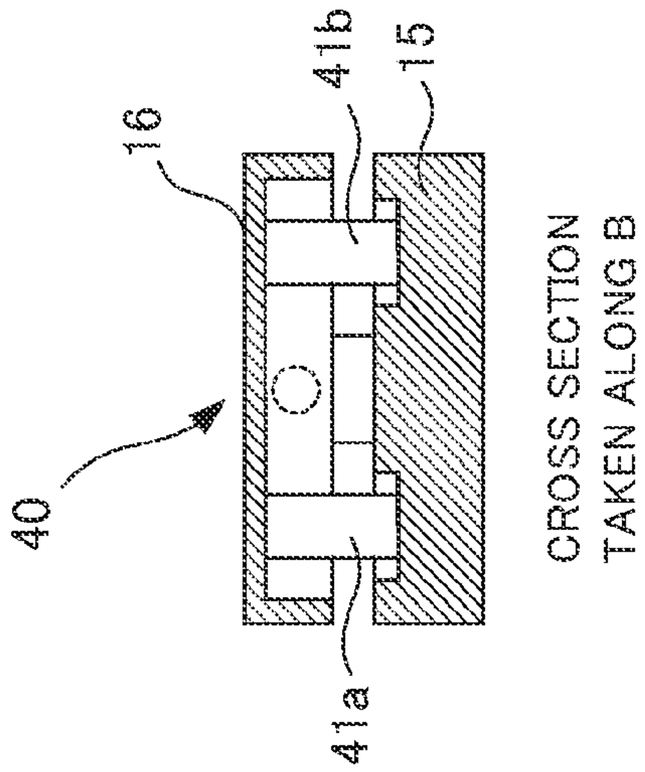


FIG.6C

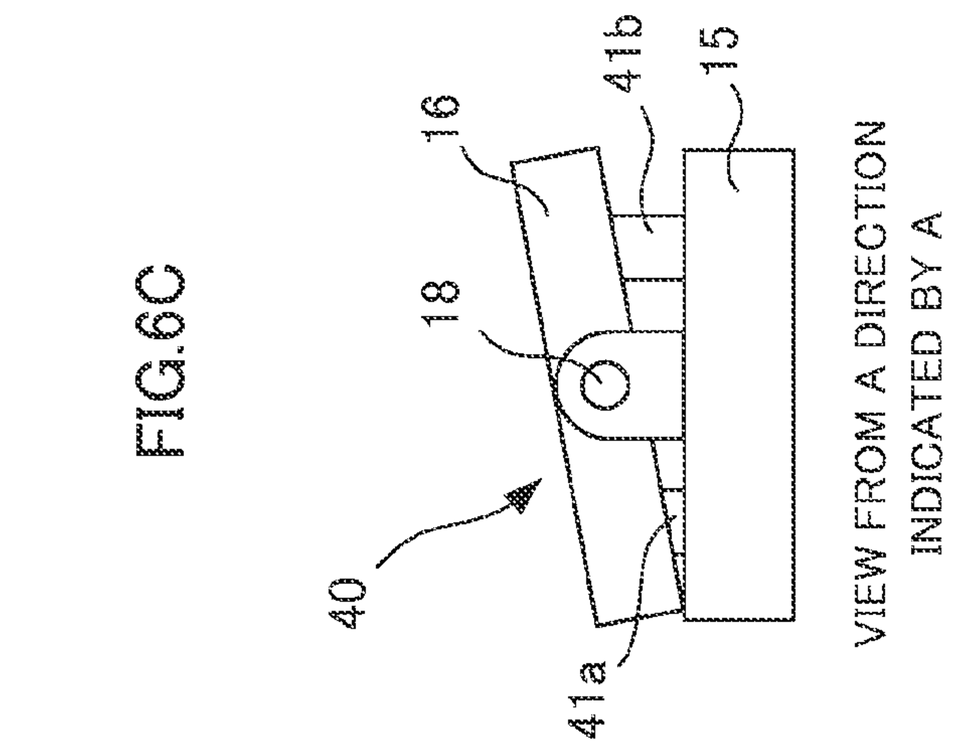


FIG.6D

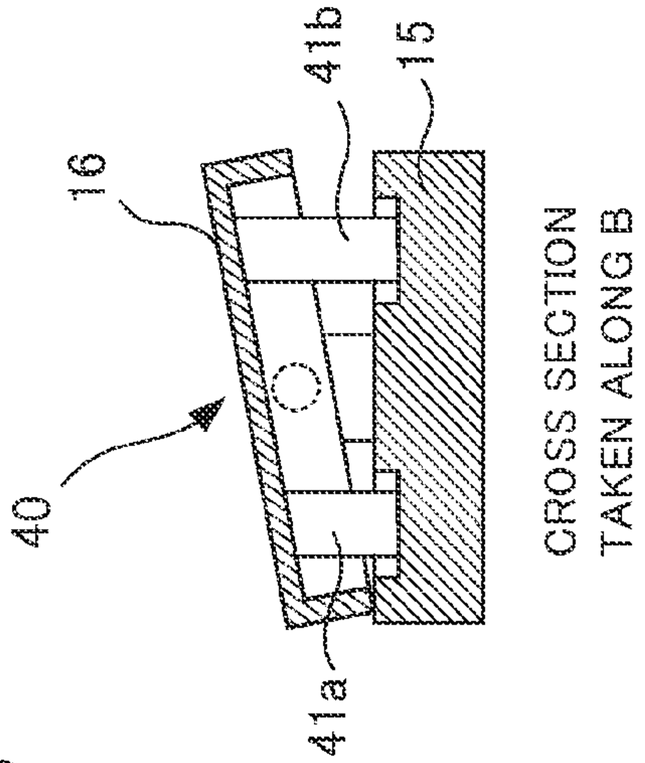


FIG.6E

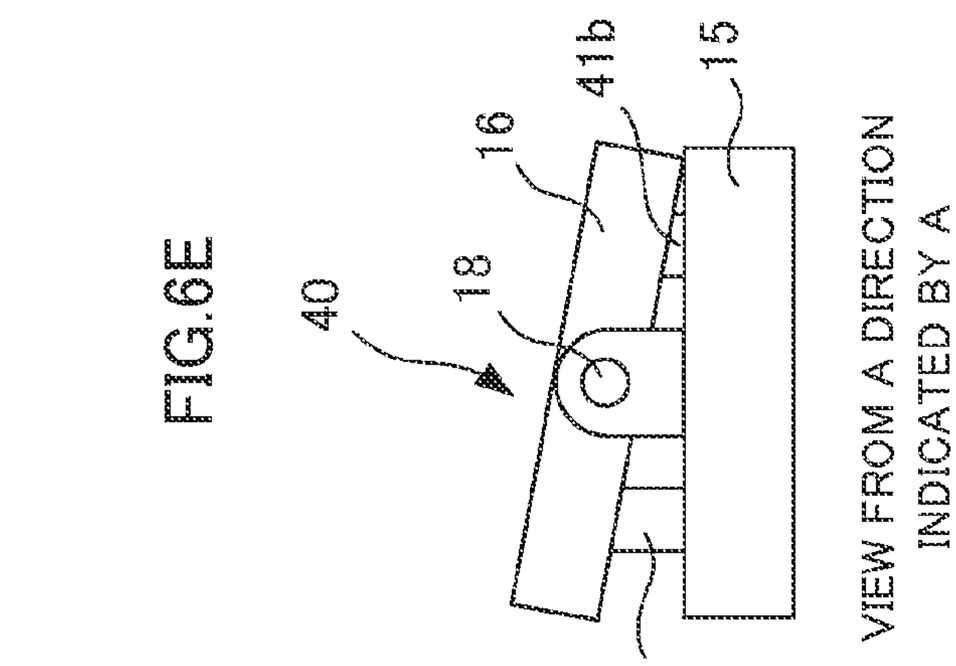


FIG.6F

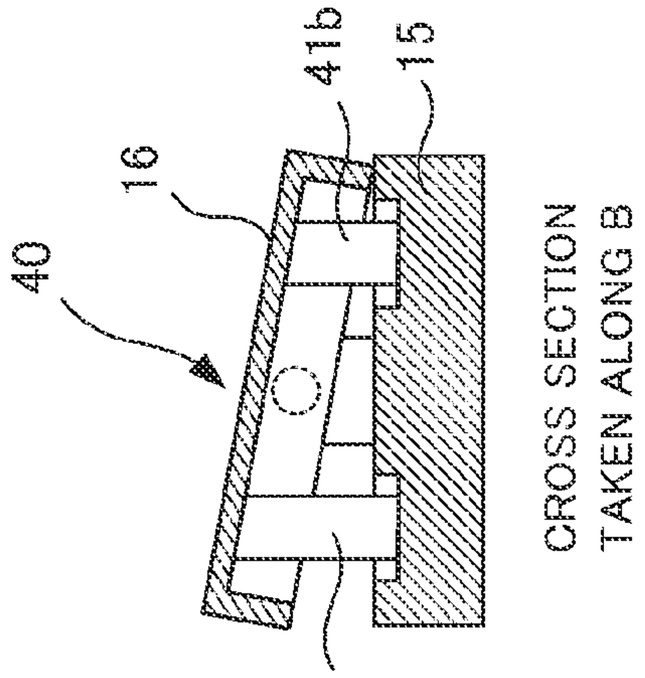


FIG.7A

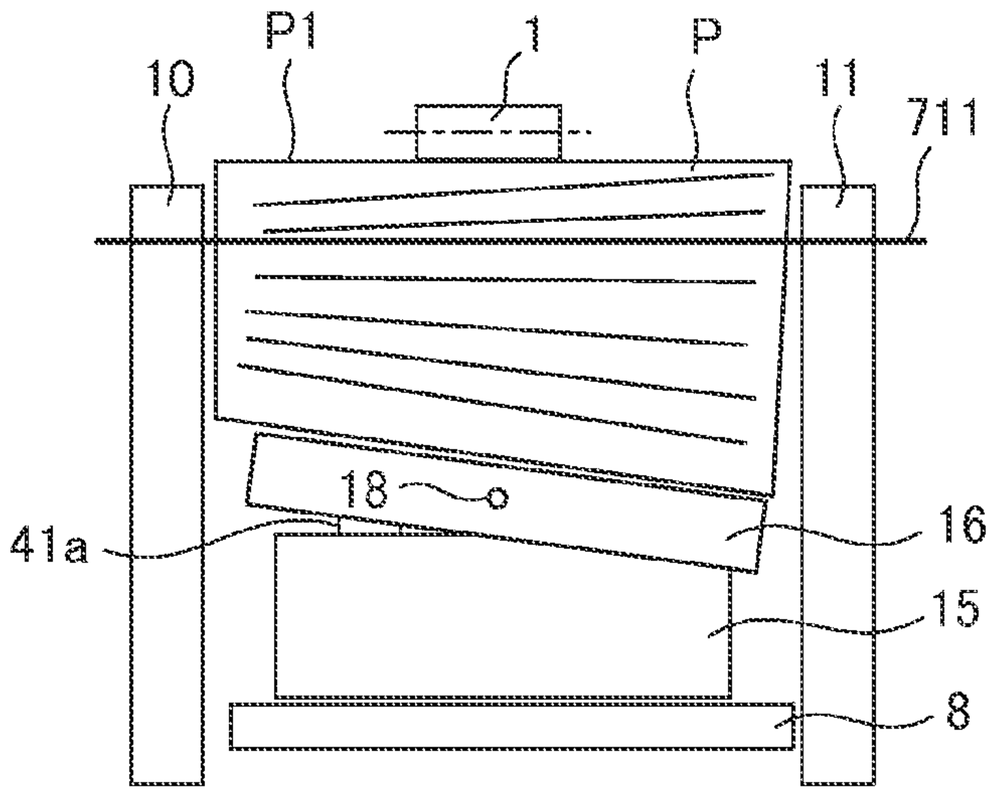


FIG.7B

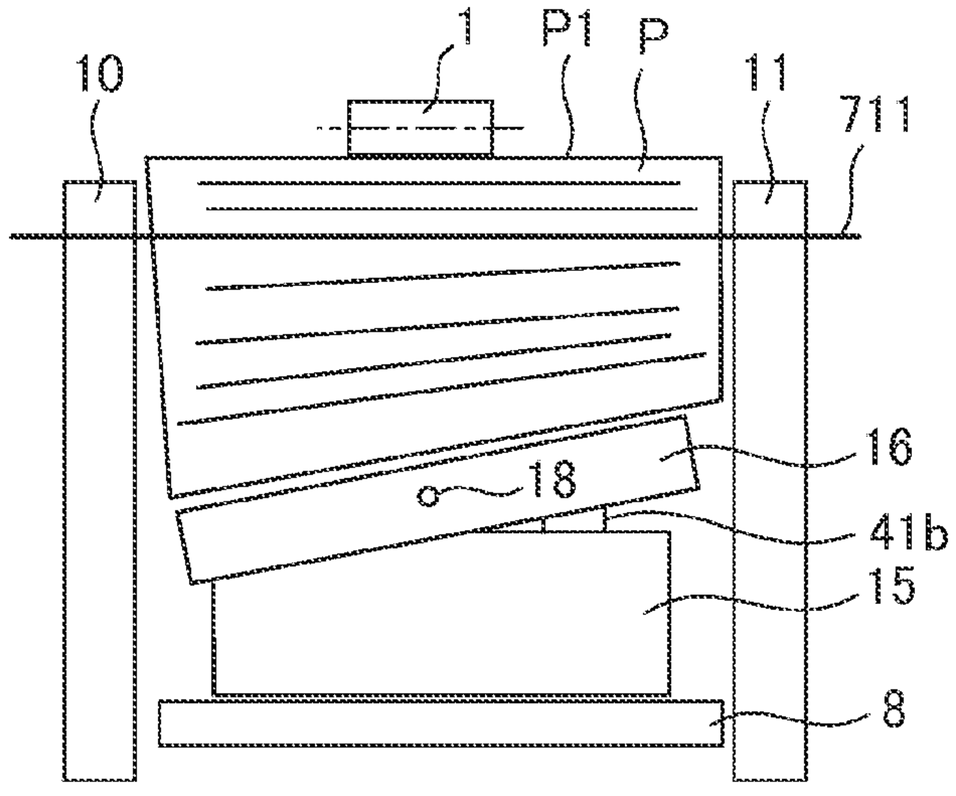


FIG.7C

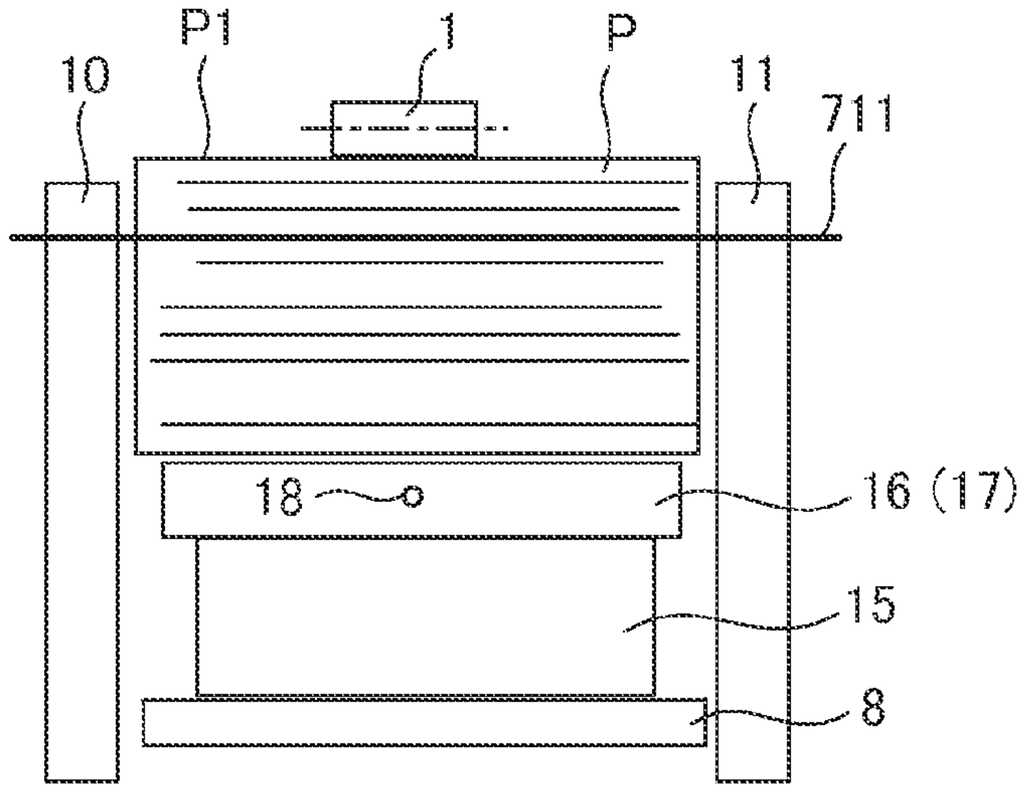


FIG.8

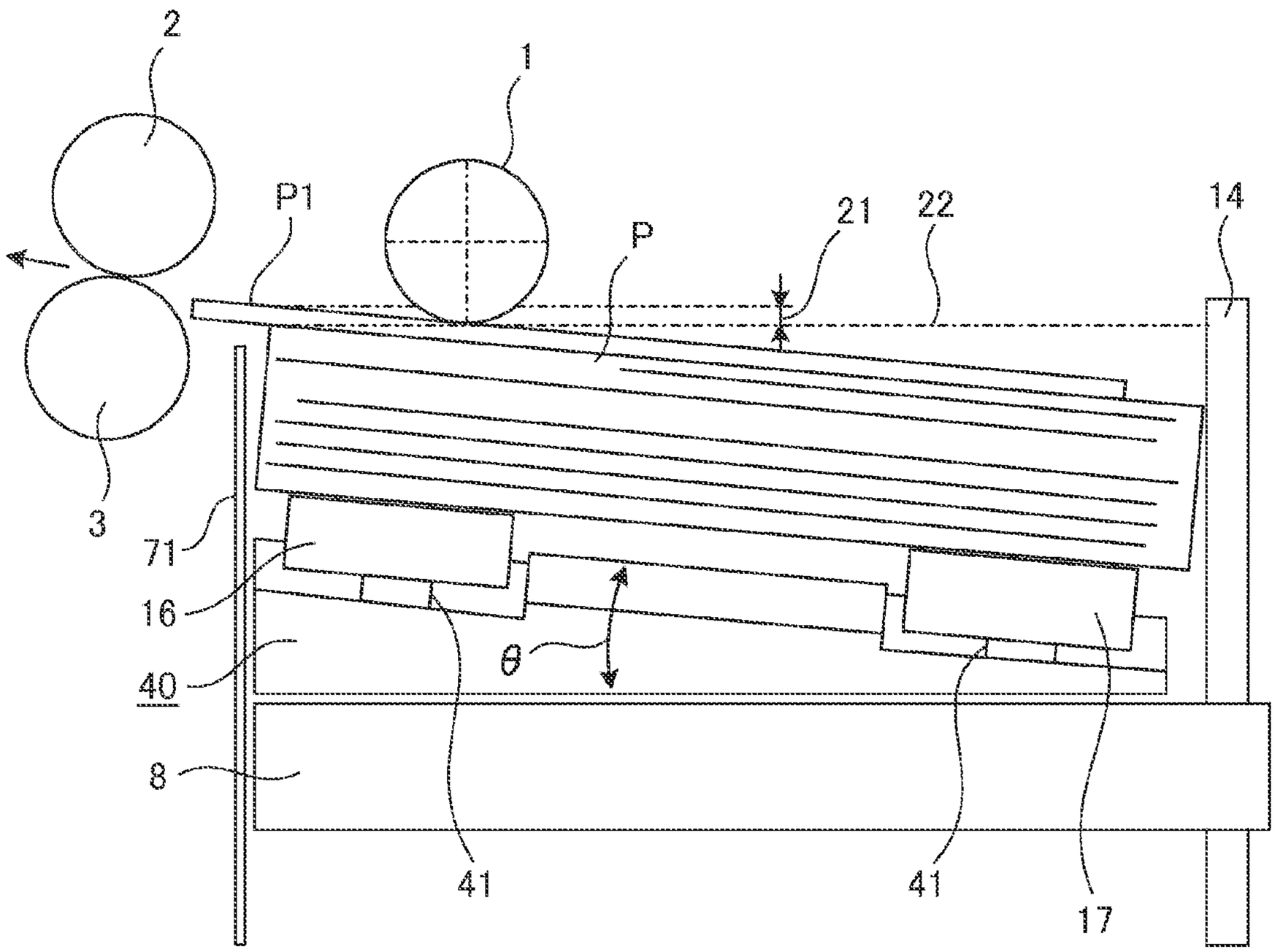


FIG.9

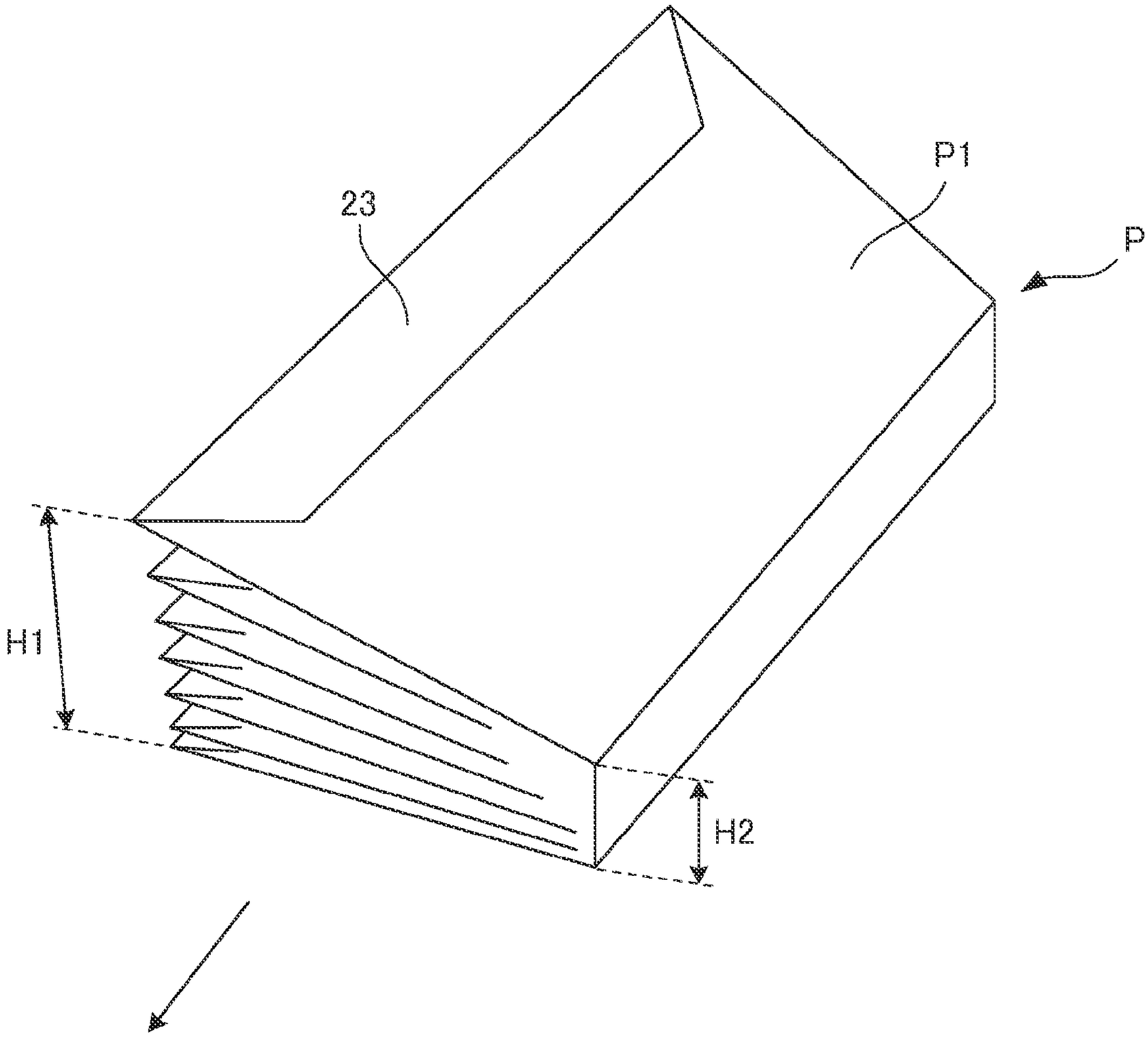


FIG.10

PRIOR ART

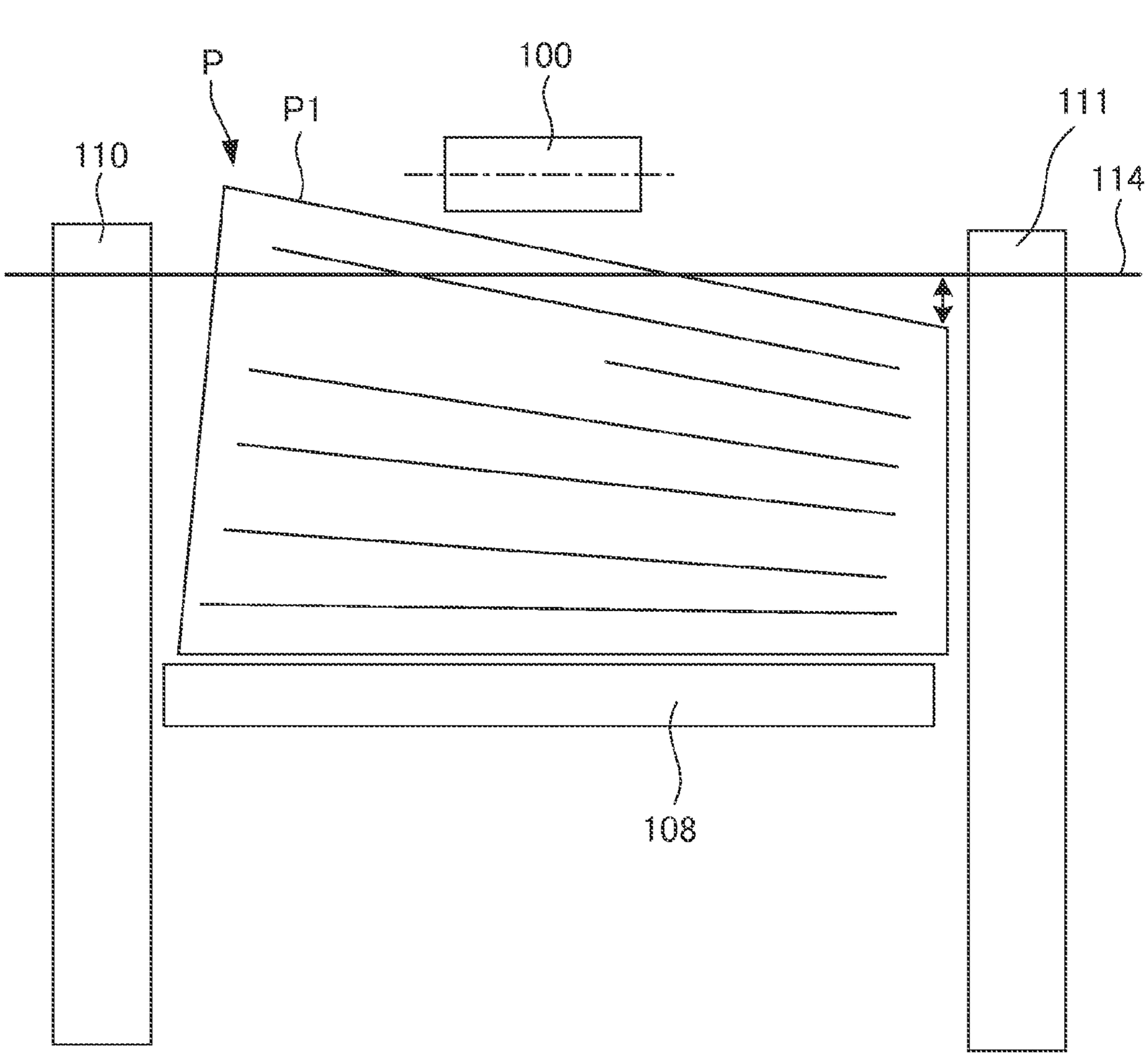


FIG.11A

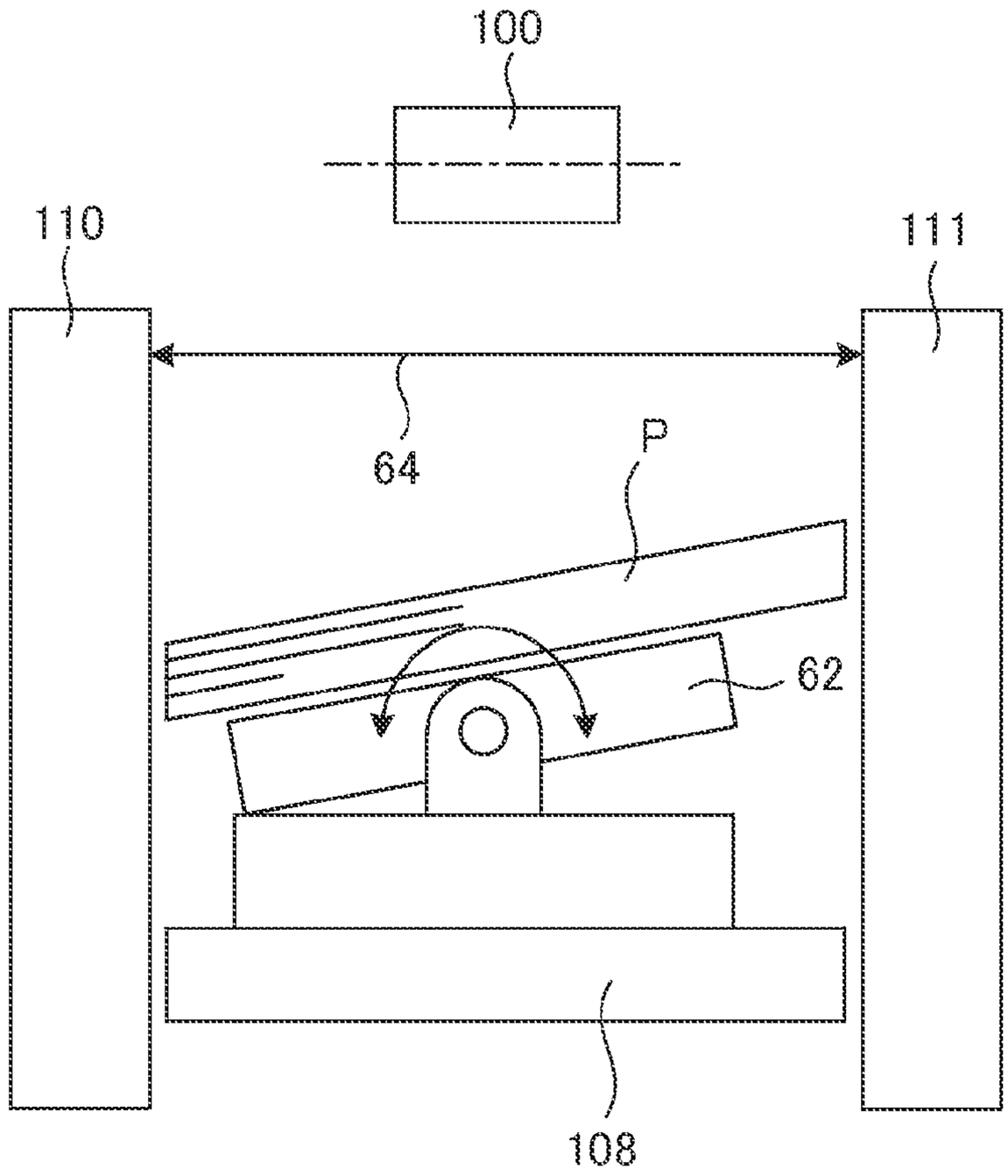
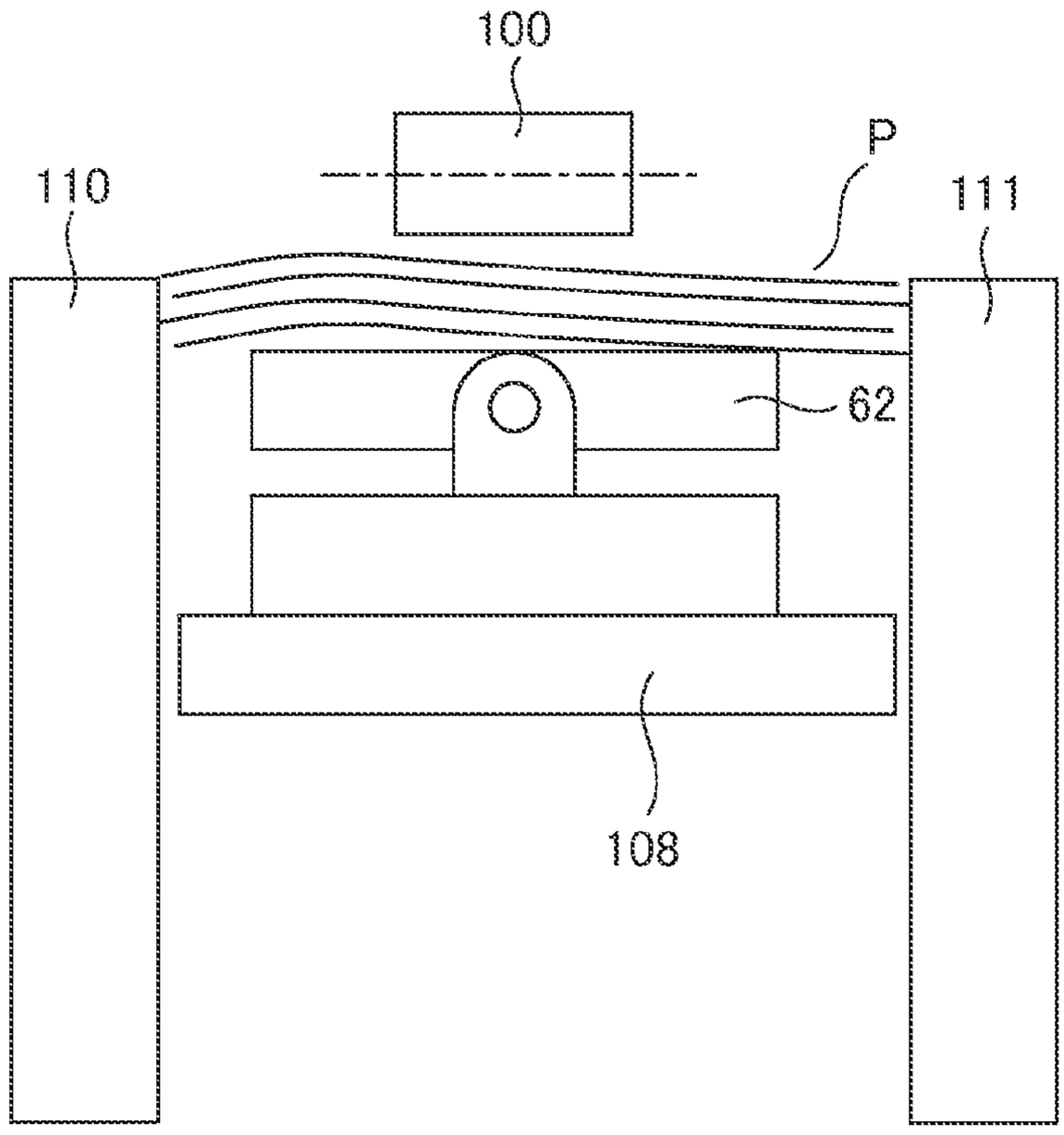


FIG.11B



SHEET STACKING APPARATUS, SHEET FEEDING APPARATUS, AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This disclosure relates to a sheet stacking apparatus, a sheet feeding apparatus, and an image forming apparatus.

2. Description of the Related Art

Nowadays, in image forming apparatus such as copying machines, printers, and facsimiles, those configured to form images on a sheet fed from a sheet feeding apparatus by an image forming portion is widely used. The sheet feeding apparatus is generally configured to demountably mount a sheet feeding cassette as a sheet storage portion configured to store sheets in an apparatus main body, and feed the sheets stored in the sheet feeding cassette by a pickup roller provided on the apparatus main body automatically.

Examples of the sheet feeding apparatus of this type include those including a tray configured to be moved upward and downward by an elevating unit so as to feed the sheets stacked on the tray of the sheet feeding cassette by pressing with a pickup roller. In addition, the sheet feeding cassette is slidably provided with a trailing end regulating unit configured to regulate positions of upstream ends of the sheets stacked on the tray in the sheet feeding direction (hereinafter, referred to as a trailing end) so as to allow sheets of different sizes to be stored. In addition, the sheet feeding cassette is provided with a pair of side end regulating units configured to regulate side end positions of the sheets stacked on the tray in a direction orthogonal to a sheet feeding direction (hereinafter, referred to as a width direction).

When feeding the sheet, side ends of the sheets on the tray are regulated by the pair of side end regulating units, and trailing ends of the sheets on the tray are regulated by the trailing end regulating unit, so that the positions of the sheets are regulated at predetermined positions. Thereafter, the tray is moved upward by the elevating unit, and the pickup roller is pressed against the sheets stacked thereon, and rotates to feed the sheets.

Examples of the sheet feeding apparatus of the related art include a type configured to feed sheets having an uneven thickness such as envelopes. Examples of the sheet feeding apparatus of this type include those configured to be provided with a specific middle plate and press the sheets stacked on the middle plate from above by a press roller in order to stack a larger amount of the sheets having an uneven thickness as disclosed in Japanese Patent Laid-Open No. H11-35175. When feeding the sheets, the middle plate is pressed by the pickup roller provided above with a spring, and the pickup roller is rotated while pressing the sheets by the press roller to feed the sheet.

In the sheet feeding apparatus of the related art having the configuration as described above, sheet conveying properties are improved to some extent by pressing a bundle of sheets having an uneven thickness with the spring or the roller to bring postures of the sheets horizontal. However, in the case where the sheets are envelopes, each envelope is provided with a flap **23** for closing an opening as illustrated in FIG. **9**. Since the shape of this flap **23** does not have a shape covering an entire surface of an envelope P but has a shape covering part of the surface of the envelope P, the thickness of a portion of the envelope P covered by the flap **23** becomes thicker than other portions. In other words, the envelope P is formed by folding a sheet into a bag shape and, in addition, the flap **23** is further folded at an end, so that the envelope P includes a

portion having a double thickness of the sheet and a portion having a triple thickness of the sheet.

Therefore, when stacking the envelopes P in the same orientation, the height H**1** on a side where the flaps **23** are located is higher than a height H**2** on the side where the flaps **23** are not located. The larger the number of the envelopes P to be stacked, the larger the difference between the heights H**1** and H**2** of the bundle of the envelopes P becomes, so that a topmost envelope P**1** is inclined significantly.

FIG. **10** illustrates a state in which the number of the envelopes P to be stacked is large, and the topmost envelope P**1** is significantly inclined in accordance with an increase of the number of the stacked envelopes P. In FIG. **10**, reference numeral **100** denotes a pickup roller configured to feed the envelope, and reference numeral **108** denotes a middle plate capable of moving upward and downward. The middle plate **108** is controlled to move upward and downward in accordance with the height of the pickup roller **100**. Reference numerals **110** and **111** denote side regulating plates configured to regulate the side end positions of the envelopes P. Reference numeral **114** denotes a side wall on the downstream side of the storage, not illustrated, configured to store the envelopes P in the feeding direction.

When the topmost envelope P**1** is inclined, the pickup roller **100** comes into abutment with an upper surface of the topmost envelope P**1** at only one end of the pickup roller **100** in the width direction, that is, a state of so-called one-side abutment, and hence cannot come into abutment with the upper surface of the topmost envelope P**1** uniformly. In this case, a feeding force of the pickup roller **100** is not transmitted to the envelope P**1** uniformly, so that a feed error due to slippage or skew caused by the one-side abutment may occur. Since the topmost envelope P**1** is inclined, a portion of the topmost envelope P**1** on the lower side is located on the lower side of the side wall **114**, and if the envelope P**1** is fed in this state, the envelop P**1** abuts against the side wall **114** and hence cannot be fed. In this manner, when a number of the envelopes are stacked, the difference in height in the stacking direction of the envelopes is increased. Therefore, there is a problem that the envelope cannot be fed reliably.

SUMMARY OF THE INVENTION

This disclosure provides a sheet stacking apparatus for supporting stacked sheets within a sheet storage portion, the sheet stacking apparatus including abase member, a sheet stacking portion on which sheets are stacked, the sheet stacking portion being supported by the base member such that both end portions of the sheet stacking portion swing up and down about a swinging center, and a biasing portion configured to bias the sheet stacking portion to reduce a swing angle.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings. The accompanying drawings, which are incorporated in and constitute apart of the specification, illustrate exemplary embodiments, features, and aspects of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a drawing illustrating a general configuration of a full-color laser beam printer that is an example of an image forming apparatus including a sheet feeding apparatus according to an embodiment of this disclosure.

FIG. **2** is a drawing illustrating a state in which a storage is pulled out from a sheet deck mounted on the full-color laser beam printer.

FIG. **3** is a first drawing for explaining a configuration of attachment to be set in the storage.

FIG. **4** is a second drawing for explaining the configuration of the attachment.

FIG. **5** is a drawing illustrating a state in which envelopes are placed on the attachment set on the sheet deck.

FIG. **6**A is a front view of the attachment in FIG. **5** in a state in which a swingable plate is not swung in a width direction when viewed in a direction indicated by an arrow A.

FIG. **6**B is a cross-sectional view of the attachment illustrated in FIG. **6**A.

FIG. **6**C is a front view of the attachment in FIG. **5** in a state in which the swingable plate swings toward a first end side in the width direction when viewed in the direction indicated by the arrow A.

FIG. **6**D is a cross-sectional view of the attachment illustrated in FIG. **6**C.

FIG. **6**E is a front view of the attachment in FIG. **5** in a state in which the swingable plate is swung toward a second end side in the width direction when viewed in the direction indicated by the arrow A.

FIG. **6**F is a cross-sectional view of the attachment illustrated in FIG. **6**E.

FIG. **7**A is a front view illustrating the attachment in a state in which the envelopes are placed and the swingable plate is swung toward the first end side in the width direction.

FIG. **7**B is a front view illustrating the attachment in a state in which the envelopes are placed and the swingable plate is swung toward the second end side in the width direction.

FIG. **7**C is a front view illustrating the attachment in the state in which the envelopes having no flap are placed on the swingable plate.

FIG. **8** is a drawing illustrating a state in which the envelopes placed on the attachment is fed out.

FIG. **9** is a drawing illustrating a state in which the envelopes are stacked.

FIG. **10** is a drawing illustrating a state in which envelopes are stacked in a sheet feeding apparatus of the related art.

FIG. **11**A is a drawing illustrating the attachment of a comparative example in a state in which the envelopes are placed on the inclined swingable plate.

FIG. **11**B is a drawing illustrating the attachment of FIG. **11**A in a state in which the swingable plate is closer to the horizontal state.

DESCRIPTION OF THE EMBODIMENTS

Hereinafter, a mode for carrying out this disclosure will be described in detail with reference to the drawings. FIG. **1** is a drawing illustrating a general configuration of a full-color laser beam printer that is an example of an image forming apparatus including a sheet feeding apparatus according to an embodiment of this disclosure.

In FIG. **1**, reference numeral **201** denotes a full-color laser beam printer (hereinafter, referred to as a printer), reference numeral **201**A denotes a printer body as an image forming apparatus body, reference numeral **201**B denotes an image forming portion configured to form an image on a sheet, and reference numeral **220** denotes a fixing unit. Reference numeral **202** denotes an image reading unit as an upper apparatus installed above the printer body **201**A substantially horizontally, and a discharge space S for discharging a sheet is formed between the image reading unit **202** and the printer body **201**A.

Reference numeral **230** denotes a sheet feeding apparatus provided in a lower portion of the printer body **201**A, reference numeral **300**A denotes a manual sheet feed unit provided on one side of the printer body **201**A and including an opening and closing tray **300** which allows manual insertion. Reference numeral **101** denotes a large-capacity sheet deck connected on one side of the printer body **201**A. Reference numeral **215** denotes a toner cartridge.

The image forming portion **201**B is of a four-drum full-color system, and includes a laser scanner **210**, and four process cartridges **211** configured to form toner images in four colors of yellow (Y), magenta (M), cyan (C), and black (K). Each of the process cartridges **211** includes a photosensitive drum **212**, a charger **213**, a developer **214**, and a cleaner, not illustrated. The image forming portion **201**B includes an intermediate transfer unit **201**C arranged above the process cartridges **211**.

The intermediate transfer unit **201**C includes an intermediate transfer belt **216** wound around a drive roller **216***a* and a tension roller **216***b*. The intermediate transfer unit **201**C is provided inside the intermediate transfer belt **216** and is provided with a primary transfer roller **219** configured to come into abutment with the intermediate transfer belt **216** at positions opposing the photosensitive drums **212**. The intermediate transfer belt **216** is formed of a film-shaped member, is arranged so as to come into contact with the respective photosensitive drums **212**, and is configured to be rotated in a direction of an arrow by the drive roller **216***a* driven by a drive unit, not illustrated.

By applying a transfer bias of a positive polarity to the intermediate transfer belt **216** by the primary transfer roller **219**, the respective color toner images on the photoconductive drums having a negative polarity are sequentially transferred to the intermediate transfer belt **216** in a superimposed manner. Accordingly, a full-color image is formed on the intermediate transfer belt. At a position of the intermediate transfer unit **201**C opposing the drive roller **216***a*, a secondary transfer roller **217** composing a secondary transfer unit configured to transfer the color image formed on the intermediate transfer belt to the sheet P is provided.

In addition, the fixing portion **220** is arranged above the secondary transfer roller **217**, and a first discharge roller pair **225***a*, a second discharge roller pair **225***b*, and a both-side inversing portion **201**D as a surface reverse discharging portion are arranged at an upper left position of the fixing portion **220**. The both-side inverting portion **201**D includes an inverting roller pair **222** as a sheet inverting and conveying roller configured to rotate in the normal direction and a reverse direction, and a re-transporting passage R configured to convey the sheet on which the image is formed on one side again to the image forming portion **201**B.

The sheet feeding apparatus **230** includes a cassette **233**, and a pickup roller **231** configured to feed the sheets P stored in the cassette **233**. The sheet deck **101** as the sheet storage portion includes a storage **7** configured to stack and store a large number of the sheets P, and a sheet feeding apparatus **102** configured to feed the sheet stored in the storage **7**. The storage **7** as the sheet storage portion body is provided so as to be capable of being pulled out from a housing **6**, and includes a lifter tray (supporting portion) **8** on which the sheets are stacked, configured to be capable of moving upward and downward. The lifter tray **8** is suspended with a wire or the like, not illustrated, and is configured to be capable of being controlled to move upward and downward in a horizontal state by a winding rotary drive of a wire pulley coupled to a motor drive.

The sheet feeding apparatus **102** includes a first feed roller **1** as a sheet feed portion configured to feed sheets stacked on the lifter tray **8**, and a second feed roller **2** and a retard roller **3** constituting part of a separating unit configured to separate the fed sheets into pieces and convey the separated sheets by the first feed roller **1** one by one. The first feed roller **1**, the second feed roller **2**, and the retard roller **3** are rollers in which a member having a high friction coefficient such as rubber is wound around a periphery thereof.

Subsequently, an image forming operation of the printer **201** will be described. First of all, when image information on a document is read by the image reading unit **202**, the image information is subjected to image processing, then is converted into an electric signal, and transmitted to the laser scanner **210** of the image forming portion **201**B. In the image forming portion **201**B, surface of the photosensitive drums **212** charged uniformly to predetermined polarity and potential by the chargers **213** are exposed in sequence by a laser beam. Accordingly, electrostatic latent images of yellow, magenta, cyan, and black are formed in sequence on the photoconductive drums of the respective process cartridges **211**.

Then, the electrostatic latent images are visualized by being developed by the toners of the respective colors and the respective color toner images on the respective photosensitive drums are overlapped and transferred in sequence on the intermediate transfer belt **216** by a primary transfer bias applied to the primary transfer roller **219**. Accordingly, a toner image is formed on the intermediate transfer belt **216**.

In parallel to the toner image forming action, the sheet P stored in the cassette **233** is fed from the pickup roller **231** provided in the sheet feeding apparatus **230**. The fed sheet P is conveyed to a registration roller pair **240** after having separated into pieces by the separating unit **232**, and a skew is corrected by the registration roller pair **240**. In the case of the manual insertion feeding, the sheet set on the opening and closing tray **300** is conveyed by the second feed roller **250** toward the registration roller pair **240**.

In the case where sheet feeding from the sheet deck **101** is specified, the sheet is fed by the first feed roller **1**, and the fed sheet is conveyed to the registration roller pair **240** by the second feed roller **2** and a pull-out roller **4**. There is a case where two or more sheets are fed by the first feed roller **1**. In such a case, entry of the second sheets onward into a nip portion between the second feed roller **2** and the retard roller **3** is blocked by the retard roller **3**, so that only the first sheet is conveyed.

After having corrected the skew, the sheet P is conveyed to the secondary transfer unit by the registration roller pair **240**, and in the second transfer unit, the toner image is transferred in a lump onto the sheet P by a secondary transfer bias applied to the secondary transfer roller **217**. Subsequently, the sheet P to which the toner image is transferred is conveyed to the fixing portion **220**, and the respective color toners are melted and mixed by being applied with heat and pressure in the fixing portion **220**, so that a color image is fixed to the sheet P.

Subsequently, the sheet P having the image fixed thereon is discharged into the discharge space S by the first discharge roller pair **225***a* and the second discharge roller pair **225***b*, provided downstream of the fixing portion **220**, and is stacked on a stacking portion **223** protruding from a bottom surface of the discharge space S. When forming an image on both sides of the sheet P, after the image has been fixed, the sheet P is conveyed to the re-transporting passage R by the inverting roller pair **222**, and then conveyed again to the image forming portion **201**B.

FIG. **2** is a drawing illustrating a state in which the storage **7** provided in the sheet deck **101** so as to be free to be pulled out in a direction indicated by an arrow **51** is pulled out toward a user from the sheet deck **101**. When storing the sheets in the sheet deck **101**, the storage **7** is pulled out to secure an operating space for storing the sheets on an upper part thereof to stack the sheets on the lifter tray **8**.

In FIG. **2**, reference numeral **9** denotes a slide rail arranged on an outer wall surface of the storage **7** on the upstream side in the sheet feeding direction for pulling out the storage **7** from the housing **6**, and the slide rail is arranged on the outer wall surface of the storage **7** on the downstream side in the sheet feeding direction. Reference numerals **10** and **11** denote side regulating members configured to regulate side end positions (positions in the width direction) of the sheet in the width direction orthogonal to the sheet feeding direction, reference sign **14** denotes a trailing end regulating member configured to regulate a position of a trailing end of the sheet, which is an upstream end of the sheet in the sheet feeding direction.

After the sheets are stacked on the lifter tray **8**, the side regulating members **10** and **11** and the trailing end regulating member **14** are set so as to meet the size of the sheet P, and then the storage **7** is closed. Accordingly, the lifter tray **8** moves upward, and then the topmost sheet of the sheet P abuts against the first feed roller **1** as the sheet feed portion. In the interior of the housing **6**, a sensor, not illustrated, configured to detect the fact that the height of the first feed roller **1** reaches a position where the sheet may be fed is provided.

Subsequently, when the lifter tray **8** moves further upward, and the first feed roller **1** is further pushed upward, the position of the first feed roller **1** moved upward is detected by the sensor, not illustrated, and a control unit, not illustrated, stops the upward movement of the lifter tray **8** by a signal from the sensor that detects the first feed roller **1**. Accordingly, feeding of the sheet is enabled. When the feed of the sheet is started to lower the height of the bundle of the sheets P and thus the first feed roller **1** is moved downward, the control unit moves the lifter tray **8** upward by a non-detection signal from the sensor. Accordingly, the position of the upper surface of the sheet P is maintained within a range of a certain height direction, and the uppermost sheets are fed by the first feed roller **1** in sequence.

In this embodiment, in the sheet deck **101**, not only the normal sheets, but also the envelopes P having different thicknesses with a flap as illustrated in FIG. **9** described above may be stored and fed. In this embodiment, when the envelopes P are stacked in the lifter tray **8**, the envelopes P are placed so that the ends folded for forming the flaps are in contact with a regulating surface of one of the side regulating members **10** and **11**. In other words, the envelopes P are stacked so that the flaps are positioned on one of the left and the right with respect to the center in the width direction extending orthogonal to the direction of sheet feeding. Here, when setting the envelopes P in the storage **7**, an attachment **40** illustrated in FIG. **3** as a sheet holding apparatus configured to hold the topmost sheet stacked on the lifter tray **8** horizontally is set on the lifter tray **8**. The attachment **40** may also be said to be a sheet stacking apparatus on which the sheets are stacked is placed on the lifter tray **8** as a supporting portion on which the attachment **40** is to be placed, and swingably supports the sheets in the storage **7**.

The attachment **40** includes a base member **15** and swingable plates **16** and **17** as swingable members supported on an upper surface of the base member **15** so as to be swingable independently in a vertical direction along the width direction via a swinging shaft **18**. The upper surface of the base member

15 is inclined and the sheet is fed along the upper surface of the base member **15**. A direction in which the sheets are fed is the sheet feeding direction, and on the attachment **40**, the downstream side is positioned to be higher by the inclination of the base member **15**. In other words, the base member **15** is inclined so that the downstream end (first end) side in the sheet feeding direction (second direction) is positioned higher than the upstream end (second end) on the side opposite to the downstream end in the sheet feeding direction.

The base member **15** includes the swinging shaft **18** configured to swingably support the two swingable plates **16** and **17** attached thereto, and the swinging shaft **18** is arranged so as to be located at a center between the side regulating members **10** and **11** in parallel to the sheet feeding direction. In other words, the swingable plate **16** is a first sheet stacking member provided on the downstream end (first end) side in the sheet feeding direction (second direction), and the swingable plate **17** is a second sheet stacking member provided on the upstream end (second end) side in the sheet feeding direction of the base member **15**. The swingable plates **16** and **17** are configured to be capable of swinging about the center (shaft center) of the swinging shaft **18** located at a substantially center of the base member **15** in the width direction as a center (swinging center) of the swingable motion **43**. That is, the swingable plates **16** and **17** are supported such that both end portions of each of the swingable plates **16** and **17** swing up and down about a swinging center **43**. The swingable plates **16** and **17** are inclined so that the downstream side is positioned higher than the upstream side along the inclination of the base member **15**, which is inclined such that a side of the first end thereof in an axial direction of the swinging center is positioned higher than a side of the second end opposite to the first end, in the sheet feeding direction. In this embodiment, the swingable plates **16** and **17** constitute part of a sheet stacking portion **19** supported by the base member **15** so as to be swingable in the width direction orthogonal to the sheet feeding direction.

Here, there is a sheet of a type configured to cause a difference in stacking height when being stacked by a plurality of numbers due to the difference in thickness between a portion having the flap and a portion having no flap like the envelope P. As described later, in the case where the envelopes as sheets having different thicknesses on the left and the right in the width direction as well in this manner, the two swingable plates **16** and **17** are swingable in a direction of arrows independently so that the topmost envelope P extends substantially horizontally.

As illustrated in FIG. **4**, arranged between the base member and the both side ends of the swingable plates **16** and **17** respectively are compression springs **41***a* to **41***d* which constitute part of biasing portions **42**. The compression springs **41***a* to **41***d* are set so as to have a resilient force at the time when the swingable plates **16** and **17** are not swung in the width direction to be substantially the same, and in this embodiment, spring constants of the respective compression springs **41***a* to **41***d* are set to be substantially the same. In this manner, the spring constants of the spring set **41***a* and **41***b*, and the spring set **41***c* and **41***d* disposed on both sides of the swinging center **43** of the swingable plates **16** and **17** in the width direction (first direction) are substantially the same. Therefore, the compression springs **41***a* to **41***d* as the biasing portion are configured to bias the swingable plates **16** and **17** as the sheet stacking portion so as to reduce a swing angle in the width direction (first direction). In this configuration, when the envelopes P are fed by the first feed roller **1** as described later, the envelopes P are fed obliquely upward (sheet feeding direction).

FIG. **5** is a drawing illustrating a state in which the envelopes P are stacked in a state in which the attachment **40** is set on the lifter tray **8**. When setting the attachment **40**, a projection, not illustrated, provided on a back surface of the attachment **40** is fitted into a positioning hole, not illustrated, on an upper surface of the lifter tray **8**.

Here, when the envelopes P are stacked, the envelopes P make an attempt to move to the upstream side in the sheet feeding direction due to the inclination of the base member **15** as described above as illustrated in FIG. **5**. However, the movement of the envelopes P is regulated by the trailing end regulating member **14**, which is slidable along the sheet feeding direction indicated by an arrow **20**. In FIG. **5**, reference numeral **71** denotes a front wall portion provided on the downstream side of the storage **7** in the sheet feeding direction, and configured to regulate the movement of the envelopes P stored in the storage **7** toward the downstream side in the sheet feeding direction.

Here, a plurality, two in this embodiment, of swingable plates **16** and **17** provided on the attachment **40** along the sheet feeding direction are held so that the upper surface of the envelope P**1** does not incline in the width direction as illustrated in FIG. **6**A and FIG. **6**B by actions of the compression springs **41***a* to **41***d* until the envelops P are stacked. FIG. **6**C and FIG. **6**D illustrate a state in which the envelopes P are stacked on the swingable plates **16** and **17** and are inclined leftward, and FIG. **6**E and FIG. **6**F illustrates a state in which the swingable plates **16** and **17** are inclined rightward on the contrary. Furthermore, FIGS. **6**A, **6**C and **6**E are drawings viewed in the direction indicated by an arrow A in FIG. **4**, and FIGS. **6**B, **6**D, and **6**F are cross-sectional views taken along a line B-B in FIG. **4**. In the following description, a state in which the swingable plates **16** and **17** are not inclined in the width direction is referred to as a horizontal state, and the swingable plate **17** is also swingable in the width direction in the same manner as the swingable plate **16** in the FIGS. **6**A to **6**F and FIGS. **7**A to **7**C.

The compression springs **41***a* to **41***d* are held with the base member **15** as a base, and bias the swingable plates **16** and **17** from below to hold the swingable plates **16** and **17** horizontally. However, the compression springs **41***a* to **41***d* are capable of being resiliently deformed easily with a weak repulsive force. Therefore, until the envelopes are stacked, or in the case where the number of the envelopes are small, since a difference in load of the envelopes applied to the left and the right on both sides of the swingable plates **16** and **17** with respect to the swinging shaft **18** are small as illustrated in FIGS. **6**A and **6**B, the swingable plates **16** and **17** are maintained substantially horizontally. When the number of the stacked envelopes increases and the difference in load of the envelope applied to the left and right of the swingable plates **16** and **17** increases, the swingable plates **16** and **17** are inclined against the resilient forces of the compression springs **41***a* to **41***d*.

Therefore, in the case where the number of the envelopes is large, that is, when the load of a predetermined magnitude is applied by the envelopes, a holding force bows to the weight of the envelopes, so that the swingable plates **16** and **17** are inclined as illustrated in FIGS. **6**C and **6**D, or FIGS. **6**E and **6**F. In other words, although the swingable plates **16** and **17** are held horizontally until the load of the predetermined magnitude is applied by the compression springs **41***a* to **41***d*, the swingable plates **16** and **17** are inclined if a load of a predetermined magnitude is applied.

Here, when the envelopes are set for the first time, the swingable plates **16** and **17** are held horizontally as illustrated in FIGS. **6**A and **6**B, and hence the envelopes are not deviated,

and the envelopes may be set easily. If a large number of the envelopes are placed, the swingable plates **16** and **17** are inclined as illustrated in FIGS. **6**C and **6**D, and FIGS. **6**E and **6**F, and if the envelopes are removed, the swingable plates **16** and **17** are returned to the horizontal state as illustrated in FIGS. **6**A and **6**B by the compression springs **41***a* to **41***d*.

FIGS. **7**A and **7**B are drawings illustrating the state of the attachment **40** when the bundle of the envelopes P is set. When the bundle of the envelope P is set, the swingable plates **16** and **17** are freely swingable, so that the side where the stacking height is large, that is, the thicker side where the flaps of the envelopes are located is lowered with the swinging shaft **18** as a supporting point and the side having the smaller stacking height is moved upward. Accordingly, the topmost envelope P**1** is brought into the substantially horizontal state. In this manner, when the bundle of the envelopes P is set, the swingable plates **16** and **17** swings so as to absorb the difference in stacking height of the bundle of the envelopes P, whereby the topmost envelope P**1** is brought into the substantially horizontal state. In FIGS. **7**A to **7**C, reference numeral **711** denotes an upper end of the front wall portion **71**.

In this manner, when the number of the envelopes P is large, the topmost envelope P**1** of the bundle of the envelopes P to be stacked thereon becomes substantially horizontal by the inclination of the swingable plates **16** and **17**. In other words, as in this embodiment, the swingable plates **16** and **17** may be inclined freely in accordance with the weight of the bundle of the envelopes P, whereby the topmost envelope P**1** of the bundle of the envelopes P may be held substantially horizontally.

By holding the topmost envelope P**1** to be substantially horizontally, the first feed roller **1** may be brought into uniform abutment with the topmost envelope P**1** without coming into one side abutment therewith, so that the envelopes P**1** may be fed without slippage. FIG. **7**C illustrates a state in which the envelopes having no flap are set for example. In this case, the swingable plates **16** and **17** are automatically balanced and the topmost envelope P**1** may be held horizontally. Hereafter, by the lifter tray **8** moving upward, the topmost envelope P**1** of the envelopes P stacked thereon is brought into abutment with the first feed roller **1** and are fed, are separated into pieces and conveyed by the second feed roller **2** and the retard roller **3**, and are fed to the printer body **201**A.

The base member **15** as described above is inclined so that the downstream side in the sheet feeding direction is positioned high. Accordingly, when being fed by the first feed roller **1**, the topmost envelope P**1** is fed obliquely upward by an angle of inclination θ of the base member **15** as illustrated in FIG. **8**. In FIG. **8**, reference numeral **22** denotes a horizontal line indicating an upper surface position of the topmost sheet in the case of feeding the normal sheet, and in the case where the normal sheets are fed, the upward and downward movement of the lifter tray **8** are controlled so that the topmost sheet is aligned with the horizontal line **22**.

As in this embodiment, by feeding the envelope P**1** obliquely upward, a distal end position of the envelope P**1** may be positioned to be higher by a height indicated by an arrow **21** with respect to the horizontal line **22** with the first feed roller **1** as a base point as illustrated in FIG. **8**. Accordingly, even with the envelope P**1** having the flap, the envelope P**1** may be caused to overcome the front wall portion **71**, and fed smoothly toward the second feed roller **2** without colliding with the front wall portion **71** of the storage. In other words, as in this embodiment, the envelope P**1** may be fed smoothly by inclining the base member **15**. In the case where the sheets having no difference in thickness such as normal sheets are stored and fed, a large capacity stacking is enabled by removing the attachment **40**, and stacking the sheets directly on the horizontal lifter tray **8**.

In this manner, in the case of the attachment **40** of this embodiment, if a large number of the envelopes are placed, the swingable plates **16** and **17** are inclined naturally. Therefore, with this effect, the topmost envelope is maintained substantially horizontally, and the side regulating members **10** and **11** may be aligned correctly with the width of the envelope P. Accordingly, the envelopes P are prevented from being set in an inclined state. In other words, as illustrated in FIG. **11**A, when the envelope P is set, it is not necessary to place the envelopes P on a significantly inclined attachment **62**, and hence the set envelopes P are prevented from being deviated toward a side regulating plate **110** on one side and hence becoming unable to be set adequately. In addition, since there is no need to set the bundle of the envelopes P on the inclined attachment **62**, and move the side regulating plates in this state in the width direction to align the ends of the envelopes P, a distance between the side regulating plates **110** and **111** indicated by an arrow **64** is not reduced by an amount of inclination to be narrower than the width of the envelopes P. Therefore, the envelopes P are fed in sequence, and the middle plate **108** moves upward, and the attachment **62** swings in the horizontal direction in association with the upward movement of the middle plate **108** and gets close to the horizontal state, the side ends of the envelopes P are not deflected by being press contacted with the side regulating plates **110** and **111** as illustrated in FIG. **11**B. In other words, aligning the side regulating members to be narrow is prevented, and generation of the load at the time of feeding the envelope P and generation of feed failure due to the slippage of a pickup roller **100** by this load may be prevented.

As described above, in this embodiment, if the envelopes are stacked so that the thicknesses are different in the width direction, the swingable plates **16** and **17** swing against the compression springs **41***a* to **41***d* so that the ends of the envelopes having a larger thickness are positioned lower than the other ends thereof, so that the topmost envelope may be held substantially horizontally. When the envelopes are stacked, the swingable plates **16** and **17** are swung to hold the topmost envelope to be substantially horizontally, so that the envelopes having a non-uniform thickness may be fed reliably.

In the description given thus far, although the attachment **40** is configured to be demountably mounted, even for that fixed to the lifter tray **8**, the same effects and advantages are achieved. Although the compression springs **41***a* to **41***d* are used for holding the swingable plates **16** and **17** horizontally, components such as a tensile spring or a rubber spring configured to generate a holding force resiliently may be employed apart from the compression spring **41**. In addition, although the two swingable plates are provided as the attachment **40**, the configuration having one swingable plate elongated in the sheet feeding direction is also applicable.

In the description given thus far, the both side ends of the swingable plates **16** and **17** are biased by the compression springs **41***a* to **41***d* to maintain the swingable plates **16** and **17** horizontally. However, this disclosure is not limited thereto, and at least one of the both side ends may be biased by a spring. That is, the biasing portion may be disposed between the base member and the sheet stacking portion on at least one of both sides with the swinging center interposed therebetween. For example, by setting the orientation of the envelopes to be set, and biasing one of the both side ends of the swingable plates **16** and **17** with the compression spring, if the envelopes are stacked, the swingable plates **16** and **17** swing to hold the topmost envelope to be horizontal.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2014-001948, filed Jan. 8, 2014, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A sheet stacking apparatus for supporting stacked sheets within a sheet storage portion, the sheet stacking apparatus comprising:

a base member;

a sheet stacking portion on which sheets are stacked, the sheet stacking portion being supported by the base member such that both end portions of the sheet stacking portion swing up and down about a swinging center;

a first biasing member biasing one end portion of the sheet stacking portion against the swinging center; and

a second biasing member biasing another end portion of the sheet stacking portion against the swinging center,

wherein both end portions of the sheet stacking portion are held at substantially the same level by the first and second biasing members.

2. The sheet stacking apparatus according to claim **1**, wherein the first and second biasing members disposed on the end portions with the swinging center interposed therebetween are configured to have substantially the same resilient force in a condition in which the sheet stacking portion is not swung.

3. The sheet stacking apparatus according to claim **1**, the base member configured to be inclined such that a side of a first end thereof in an axial direction of the swinging center is positioned higher than a side of a second end opposite to the first end.

4. The sheet stacking apparatus according to claim **1**, wherein the sheet stacking portion includes a first sheet stacking member provided on a side of a first end of the base member in an axial direction of the swinging center, and a second sheet stacking member provided on a side of a second end, opposite to the first end in the axial direction, of the base member, and

wherein each of the first and the second stacking members is configured to swing about the swinging center.

5. The sheet stacking apparatus according to claim **4**, wherein the base member is configured to be inclined such that the side of the first end in the axial direction of the swinging center is positioned higher than the side of the second end.

6. The sheet stacking apparatus according to claim **1**, wherein the first and second biasing members reduce a swing angle of the sheet stacking portion.

7. The sheet stacking apparatus according to claim **1**, wherein the first and second biasing members respectively include a compression spring.

8. A sheet feeding apparatus comprising:

a sheet stacking apparatus including:

a base member;

a sheet stacking portion on which sheets are stacked, the sheet stacking portion being supported by the base member such that both end portions of the sheet stacking portion swing up and down about a swinging center;

a first biasing member biasing one end portion of the sheet stacking portion against the swinging center; and

a second biasing member biasing another end portion of the sheet stacking portion against the swinging center;

a sheet storage portion including a sheet storage portion body configured to store sheets, and a supporting portion which is provided on the sheet storage portion body so as to be capable of elevating, and on which the base member of the sheet stacking apparatus is placed; and

a sheet feed portion provided above the supporting portion and configured to feed the sheet in abutment with the topmost sheet from among the sheets stacked on the sheet stacking portion,

wherein both end portions of the sheet stacking portion are held at substantially the same level by the first and second biasing members, and

wherein the axial direction of the swinging center corresponds to a sheet feeding direction.

9. The sheet feeding apparatus according to claim **8**, wherein the base member is configured to be inclined such that a first end side in the sheet feeding direction as a downstream side in the sheet feeding direction is higher than a second end side in the sheet feeding direction as an upstream side in the sheet feeding direction.

10. The sheet feeding apparatus according to claim **8**, wherein the sheet stacking apparatus is configured to be demountably mountable with respect to the supporting portion.

11. The sheet feeding apparatus according to claim **8**, further comprising a side regulating member configured to regulate the position of the sheets stacked on the sheet stacking portion in a width direction orthogonal to the axial direction of the swinging center.

12. An image forming apparatus comprising:

a feeding apparatus including:

a sheet stacking apparatus including:

a base member;

a sheet stacking portion on which sheets are stacked, the sheet stacking portion being supported by the base member such that both end portions of the sheet stacking portion swing up and down about a swinging center;

a first biasing member biasing one end portion of the sheet stacking portion against the swinging center; and

a second biasing member biasing another end portion of the sheet stacking portion against the swinging center;

a sheet storage portion including a sheet storage portion body configured to store sheets, and a supporting portion which is provided on the sheet storage portion body so as to be capable of elevating, and on which the base member of the sheet stacking apparatus is placed; and

a sheet feed portion provided above the supporting portion and configured to feed the sheet in abutment with the topmost sheet from among the sheets stacked on the sheet stacking portion; and

an image forming portion configured to form an image on a sheet fed by the sheet feeding apparatus,

wherein both end portions of the sheet stacking portion are held at substantially the same level by the first and second biasing members, and

wherein the axial direction of the swinging center corresponds to a sheet feeding direction.

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